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IDENTIFIERS	*West Virginia

ABSTRACT

A project was undertaken to identify machine shop occupations requiring workers to use computers, identify the computer skills needed to perform machine shop tasks, and determine which software products are currently being used in machine shop programs. A search of the Dictionary of Occupational Titles revealed that computer skills will become increasingly important for machine tool operators, machinists, patternmakers, tool and die makers, and setup operators. Students in machine shop programs should also become comfortable operating a computer and should develop computer literacy skills for the unskilled programmer. A survey mailed to 23 West Virginia machine shop teachers was completed by only 7 instructors. Of these, only two reported using a computer system in their machine shop program, and although all seven respondents liked the idea of using a computer literacy text statewide, they could not agree on a suitable text. All of the data gathered during the project indicate that there is a definite need to develop training systems for use in machine shop programs in West Virginia and to supplement such programs with instruction in technical math. (Appendixes to this report include samples of the surveys sent to teachers and software companies, sample software evaluation forms, and lists of machine shops and companies included in the survey.) (MN)

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FINAL REPORT

USING MICROCOMPUTERS IN VOCATIONAL EDUCATION TO TEACH NEEDED SKILLS IN MACHINE SHOP AND RELATED OCCUPATIONS

Mercer County Vocational Technical Center
105 Old Bluefield Road
Princeton, W.V.

Herley Bailey
Project Director

WV-84-5-6

U.S. DEPARTMENT OF EDUCATION
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INTRODUCTION

In order to succinctly evaluate the effectiveness of this program we will first reiterate the program objectives, secondly we will supplement the original report with program objectives that seemed to be pertinent to the projects success. After stating each objective a brief explanation or outcome will be given. In the subsequent sections we will provide additional information in each area.

OBJECTIVES

1. Identify Machine Shop Occupations which require the use of computers in their performance. Information was gathered from the most recent publications of Chronicle Guidance in their Occupational Briefs. The information is directly correlated with the Dictionary of Occupational Titles.

2. Select machine shop processes which are most common and identify the computer skills needed. The IBM and Commodore 64 basic literacy programs were used for this information as well as the CNC program description.

3. Conduct a survey of West Virginia Vocational Machine Shop instructors to determine software being used presently and have them complete an evaluation form on each software package. Twenty-three questionnaires and software evaluation forms were sent out on 11/8/83 with a stamped, self-addressed envelopes.

4. Conduct a survey of other sources to identify additional software packages which are available and evaluate each package. Surveys were sent to 19 companies, two software packages were sent and reviewed, numerous amounts of literature was reviewed.

5. Use computer-assisted instruction in the selected processes if desirable and feasible. Machine shop software developed at center for the IBM Network.

6. Present the outcomes of the project at the spring conference of local vocational directors. Presentation given at the August conference in conjunction with the CNC representative.

7. Submit a written report of project outcomes and materials.

Occupations

The Dictionary of Occupational Titles breaks down job skills and competencies into specific areas. Chronicle Guidance Briefs are published periodically giving descriptions of job areas and their particular requirements. The most recent publications that we selected have outlined the following occupational areas: Machine Tool Operators, Machinists, Patternmakers, Toolmakers and Diemakers, Setup Operators (Machine Shop). Each of these occupational areas all stress the necessity of computer related skills for this field, in addition some of the areas stress the fact that there is a need for both skilled and unskilled workers depending upon the sophistication of the business in question. For example, a CNC program will have a need for the skilled worker to program and set up the system, in addition they will have a need for unskilled workers to simply load the machines.

Occupations

Tool and DieMakers will become ever more increasingly specialized workers needing to have both skills of craftsmanship and computer operation. The workers in this area will be in high demand and will not be likely to be layed off due to the employers need for skilled individuals in this area. All of the abstracts reviewed stressed the importance of computer numerical control systems in the field at present and the need for programmers for such systems. Despite the fact that there are numerous positions for programmers, one programmer can set-up for twice the amount of machinists that were required in the past.

Machine Processes/Computer Skills

The project employed the use of two computer systems. The Paxton/Patterson CNC Training Center and the Commodore 64 Computer system, monitor, printer and floppy disc. Both of these systems are designed to achieve computer literacy for the unskilled computer programmer. The student is gradually introduced to both of these systems with the first objective being to become comfortable with the operation of the computer. The CNC system is designed to teach both part programming and Machining that will simulate the actual work environment in the hopes that the student can become familiar with the entry level skills that are required of the worker. In order to successfully complete the programming of these units the students are given a review of their basic math skills. The review of these basic skills is the first step required in order to have the skills to program the system, after mastery of skills the student is then introduced to the trigonometry necessary for using the computer systems. Despite the fact that these skills are high level math skills and most of the students have not had the opportunity to gain such proficiency our math instructor is able to teach the necessary skill development in order to successfully accomplish programming of both computers. In addition to these units of study time is allocated for the student to be involved in the IBM Computer Lab. The materials and information within this system may prove to be the most valuable in terms of information for the student to learn in order to use the other systems. A program for testing Machine Shop skills has been developed for the Network and is reviewed in the Appendix. Private Tutor offers numerous programming possibilities for the instructor. After acquiring the necessary training on developing such programs the instructor can make permanent copies of disc containing needed materials for their instructional units. This software can be stored at the Computer Center in Cedar Lakes for use by all the Machine Shop programs in the state.

All of these computer systems give step by step instructions for operation of the particular system. Lecture and discussion are used to explain the necessary information for G codes and other processes needed for learning cutting procedures. Most importantly they provide for hands on experiences for each individual to improve their skills.

The units that are taught through both the CNC and the personal computers as outlined by the Machine Shop Learning Outcomes are as follows: Microcomputers-Item 22,23, Layout, all the Drill Press competencies, Program, set-up, and operate a computerized numerical control machine, all Milling Machine competencies.

It is also advisable that a math program for Machine Shop also be incorporated into this curriculum. We have taken a look at the math necessary for the computer operation, but it is also important that Basic Geometry, Circular Geometry, and Trigonometry be incorporated, specifically in the use of gears and helix's.

Survey of Vocational Machine Shops

A survey was sent to all instructors throughout the state. A copy of the letter is found in the appendix. Twenty-three questionnaires were sent out and only seven were returned. Along with the questionnaires we sent software evaluation forms to each individual in the hopes that we could locate some software presently in use. We did not receive any software evaluations back. This was our first indication of the difficulty in finding software for this field. There were only two individuals of the seven responding that even had a computer system. Both of these individuals stated that the systems they have use their own software and that they have not employed any other. Within this survey we also asked about the use of a text book, all respondants liked the idea of using the same text statewide, particularly with the beginning of the computer network. There did not seem to be any agreement on what that text should be.

Survey for Software

A survey was sent to 15 companies based upon information received on some areas in which companies are doing work for CNC systems. The companies are listed in the appendix. In addition an evaluation was written on the CutData system that was sent to us by the State Department for our review. This material is also available in the appendix. Of all the companies polled only one company sent materials back for our review. The Comprep co. of Orange Ca. sent information on their CNC systems. Most of the material that we reviewed was directly correlated to industry and not used for training purposes alone. The materials were also very expensive for a vocational training setting. For example, Comprep's material ranged in price from $500.00 to $9995.00. The $500.00 package is simply a review of information that can easily be gained from a text and would not need to be computerized. This company does produce material for the IBM and therefore would be helpful to the West Virginia system. It is highly recommended that the earch for software continue. The use of such training systems could be successful or be a failure dependent upon the amount of software that can be found for use by the instructor. The time necessary for development of your own software may not be available to all instructors.

Computer assisted instruction

Computer assisted instruction is the most important element of this type of program. The use of several different types of computer systems is also advisable. Certain types of instruction need different equipment in order to effect its success: for example, in order to understand a CNC system a student must have hands on experience as given by the Paxton/Patterson CNC Training Center, development of skills for computer literacy need to be accomplished through using the Commodore 64 or IBM systems specifically working with graphics that will help to explain layout work and use. In addition there should be larger systems such as a computerized Milling Machine in order to demonstrate on a larger scale the use of these previously learned systems. Therefore, it is our recommendation that if computerized systems are used that they be multi-faceted and be able to help the student learn a variety of skills rather than just one component. This is the demand of industry at the present time as indicated by the information we have gathered.

Future Needs

All of the information that we have gathered indicates that there is a need for the development of training programs for CNC systems in the machine shop trades. All shops are exposed to this process whether small or large in one sense or another. Computer literacy will be mandatory for students in the not so distant future. Therefore, it is important to develop such programs. In this development we must put particular emphasis on the selection process. Due to the fact that there are so many companies trying to sell products in this field this becomes more difficult. It is our experience that the companies are as baffled by this problem as the potential consumer may be. Software in particular is difficult to locate for the systems you may decide upon. As previously mentioned the IBM seems to have a good amount of software for this field and are interested in producing more. This production is going to take time as we have seen there is a limited amount of material for teaching purposes that is also low cost so that vocational training programs could use it.

The use of microcomputers is increasing, but just as fast the use of larger computerized systems is increasing also. Milling Machines that can accomplish work projects of a large scale are going to become very predominant in industry and therefore must be introduced into our vocational training programs. The smaller scale systems can be used as a basis for more advanced training within this field.

Lastly the need for technical math within our Machine Shop programs becomes more and more important with the development of such advanced computer systems. Programs dealing with the development of learning outcomes and competencies in these areas need to be completed. The ideal way to implement such learning may be through the computer network system, in this manner a particular machine shop program could be charged with the development of particular skills in a certain area and it could be put through the network using Private Tutor.

The field of computerization in industry is growing so rapidly that it may prove all programs to obsolete within a few months, this is not a good rationale not to become involved, but caution should be taken to ensure that the proper selections of equipment and materials are made.

APPENDIX

I. Sample survey to Machine Shop Instructors

II. Sample survey to Companies

III. Software Evaluation Forms
    1. CutData
    2. Private Tutor - Machine Shop Safety
    3. Private Tutor - Welding Safety

IV. Machine Shops included in the survey

V. Companies included in the survey

I. Survey to Machine Shop Instructors

November 8, 1983

Machine Shop Instructors:

The West Virginia Department of Vocational Education has proposed a project using computers in Machine Shop Programs. As the project director, I am interested in computer activities now in use in your program.

This project will eventually tie into vocational schools and their machine shop classes via telephone and computer through the statewide computer network. Sharing of information through the computerized system will be beneficial to all machine shop instructors.

Please complete the evaluation form enclosed as it pertains to your existing program. If you would, also include the name of the text that you are currently using and/or the curriculum guide that you use most often. A stamped, addressed envelope has been provided for your reply. I appreciate your assistance and will be looking forward to your response. If you need additional copies please copy the form enclosed.

Sincerely,

Herley Bailey

Herley Bailey
Project Director
Machine Shop Instructor

MERCER COUNTY VOCATIONAL TECHNICAL CENTER
105 Old Bluefield-Princeton Road, Princeton, West Virginia 24740-8901
(304) 425-9551 (304) 327-9109

II. Survey to Companies

We are conducting a search for software in the Machine Technology area. We are a vocational education center using both IBM/PC and Commodore 64 microcomputer systems in our Machine Shop. Any assistance you could give us would be appreciated. Please send information catalogs/demonstration disks to the address below, to my attention. Thank-You for your assistance.

Sincerely,

Herly Bailey

Herly Bailey

Program Area MACHINE SHOP

Software Evaluation Form

Software Title CutData Medium: x 5" disk; ____ 8" disk; ____

____ cartridge; ____ tape

Microcomputer Required: Brand IBM

Model PC

Memory 192k

Source of Software Metcut Research Associates Inc

3980 Rosslyn Dr. Cincinnati Ohio 45209

Back-up Copy Policy License Agreement Software Cost $5,000.00

complete set with handbo

PART 1 Program Overview and Description

1. Specific topic/skill Machinability DATA Modules

2. Purpose of Software: Teach Computer Literacy ____

Teach Computer Operation ____

Teach Specfic Operation ____

Other Information file for Machining Processes

3. Appropriate grade level (circle) 1 2 3 4 5 6 7 8 9 10 (11 12 adult)

4. Type of program (check one or more)

____	Simulation	____	Tutorial	____	Testing
____	Educational Game	____	Problem Solving	____	Motivational
____	Drill and Practice	____	Authoring System	____	Remediation
✓	Other (specify) Information file for using Turning, Milling, Hole Making etc.				

5. Appropriate group instructional size: ✓ individual ____ small group ____ large group

6. Does the software stand on its own, or should it be supplemented with other types of materials: ____ Yes ____ No No, doesn't stand on own - must be used as information

7. What is the target audience: (average) remedial, gifted. (circle one)

8. Time Required 5 minutes (minutes "estimated" for average use)

PART 2 Evaluation Checklist

Please check Yes, No, or Not Applicable for each question below. To add information, or to clarify an answer, use "Comments" section.

Yes	No	N/A		
✓			1.	The program loads properly and runs without system errors.
	✓		2.	The content has educational value.
✓			3.	The program content is free of race, ethnic, sex, and other sterotypes.
✓			4.	The grammar, spelling and punctuation are correct.
✓			5.	The program is free of technical problems.
✓			6.	The instructions are clear.
		✓	7.	The curriculum-material is logically presented and well organized. no curriculum material
		✓	8.	Graphics, sound, and color, if used do enhance the instructional presentation. no instructional presentation
✓			9.	The frame display is clear and easy to read.
✓			10.	Students can easily and independently operate the program.
	✓		11.	The feedback is effective and appropriate. no curriculum orient
		✓	12.	Cues and prompts help students to answer questions correctly. no questions
		✓	13.	Students can control the pace and sequence of the program.
✓			14.	There are safeguards against students "bombing" the program by erroneous inputs.
		✓	15.	The program evaluates final student mastery or provides total scores. no mastery required.
	✓		16.	Record-keeping is possible (within the program or through documentation worksheets)
✓			17.	The teacher must monitor student use.
	✓		18.	Teacher can modify the program.
✓			19.	Documentation is clear and comprehensive.

COMMENTS: CutData is an information source, no curriculum material is presented. It mearly offers graphs and charts for finding speeds, depths, Amounts of fluids metric conversions in thi format. Feedback is not asked for or required.

PART 3 Overall Evaluation

CHECK ONE.

- ___ Excellent program. Recommend without hesitation.
- ___ Pretty good program. Consider purchase.
- ___ Fair. But might want to wait for something better.
- ✓ Not useful. Do not recommend purchase.

Reviewer Name Herley Bailey

Program Area MACHINE SHOP

Software Evaluation Form

Software Title Private Tutor
MACHINE SHOP SAFETY

Medium: ✓ 5" disk; ____ 8" disk;
____ cartridge; ____ tape

Microcomputer Required: Brand IBM
Model PC
Memory ____

Source of Software PRIVATE TUTOR
Machine Shop Safety. Mercer County Vo-Tech. Ctr.

Back-up Copy Policy Copies Allowed Software Cost no cost

PART 1 Program Overview and Description

1. Specific topic/skill MACHINE SHOP SAFETY

2. Purpose of Software: Teach Computer Literacy ____
Teach Computer Operation ____
Teach Specfic Operation ____
Other Testing/Review of Curriculum Requirements

3. Appropriate grade level (circle) 1 2 3 4 5 6 7 8 9 10 (11 12 adult)

4. Type of program (check one or more)

____ Simulation	____ Tutorial	✓ Testing
____ Educational Game	____ Problem Solving	____ Motivational
✓ Drill and Practice	✓ Authoring System	✓ Remediation
____ Other (specify) ____		

5. Appropriate group instructional size: ✓ individual ✓ small group ✓ large group

6. Does the software stand on its own, or should it be supplemented with other types of materials: ✓ Yes ____ No Stands on Oun, Supplements Machine Shop Curriculum

7. What is the target audience: (average,) remedial, gifted. (circle one)

8. Time Required 30 minutes (minutes "estimated" for average use)

PART 2 Evaluation Checklist

Please check Yes, No, or Not Applicable for each question below. To add information, or to clarify an answer, use "Comments" section.

Yes	No	N/A		
✓			1.	The program loads properly and runs without system errors.
✓			2.	The content has educational value.
✓			3.	The program content is free of race, ethnic, sex, and other sterotypes.
✓			4.	The grammar, spelling and punctuation are correct.
✓			5.	The program is free of technical problems.
✓			6.	The instructions are clear.
✓			7.	The curriculum material is logically presented and well organized.
✓			8.	Graphics, sound, and color, if used do enhance the instructional presentation.
✓			9.	The frame display is clear and easy to read.
✓			10.	Students can easily and independently operate the program.
✓			11.	The feedback is effective and appropriate.
		✓	12.	Cues and prompts help students to answer questions correctly.
✓			13.	Students can control the pace and sequence of the program.
✓			14.	There are safeguards against students "bombing" the program by erroneous inputs.
✓			15.	The program evaluates final student mastery or provides total scores.
✓			16.	Record-keeping is possible (within the program or through documentation worksheets)
✓			17.	The teacher must monitor student use. Teacher would want to be present to see student evaluation
✓			18.	Teacher can modify the program.
✓			19.	Documentation is clear and comprehensive.

COMMENTS: Machine shop safety test put into private tutor/stored on Corvus. 15 Ready for immediate use - student not required to handle Diskettes. Will shake with any interested party

PART 3 Overall Evaluation

CHECK ONE.

✓ Excellent program. Recommend without hesitation.
___ Pretty good program. Consider purchase.
___ Fair. But might want to wait for something better.
___ Not useful. Do not recommend purchase.

Reviewer Name Herley Bailey

Program Area Welding Machine Shop
Building Construction, Auto Body

Software Evaluation Form

Software Title Private Tutor - Welding Safety Medium: ✓ 5" disk; ____ 8" disk;

____ cartridge; ____ tape

Microcomputer Required: Brand IBM

Model P.C.

Memory ____

Source of Software Private Tutor

Welding Safety - Mercer County Vo-Tech Center

Back-up Copy Policy Copies Allowed Software Cost $0.00

PART 1 Program Overview and Description

1. Specific topic/skill Welding Safety - Review of 13 different safety areas-could be used by other Vocational Programs.
2. Purpose of Software: Teach Computer Literacy ____
   Teach Computer Operation ____
   Teach Specfic Operation ____
   Other Testing/Review of Curriculum Requirements
3. Appropriate grade level (circle) 1 2 3 4 5 6 7 8 9 10 11 12 adult
4. Type of program (check one or more)

____ Simulation	____ Tutorial	✓ Testing
____ Educational Game	____ Problem Solving	____ Motivational
✓ Drill and Practice	✓ Authoring System	✓ Remediation
____ Other (specify) ____		

5. Appropriate group instructional size: ✓ individual ✓ small group ✓ large group
6. Does the software stand on its own, or should it be supplemented with other types of materials: ✓ Yes ____ No Stands on own, Supplements Welding Curriculum
7. What is the target audience: (average), remedial, gifted. (circle one)
8. Time Required 30 minutes (minutes "estimated" for average use)

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PART 2 Evaluation Checklist

Please check Yes, No, or Not Applicable for each question below. To add information, or to clarify an answer, use "Comments" section.

Yes	No	N/A		
✓			1.	The program loads properly and runs without system errors.
✓			2.	The content has educational value.
✓			3.	The program content is free of race, ethnic, sex, and other sterotypes.
✓			4.	The grammar, spelling and punctuation are correct.
✓			5.	The program is free of technical problems.
✓			6.	The instructions are clear.
✓			7.	The curriculum material is logically presented and well organized.
✓			8.	Graphics, sound, and color, if used do enhance the instructional presentation.
✓			9.	The frame display is clear and easy to read.
✓			10.	Students can easily and independently operate the program.
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		✓	12.	Cues and prompts help students to answer questions correctly.
✓			13.	Students can control the pace and sequence of the program.
✓			14.	There are safeguards against students "bombing" the program by erroneous inputs.
✓			15.	The program evaluates final student mastery or provides total scores.
✓			16.	Record-keeping is possible (within the program or through documentation worksheets)
✓			17.	The teacher must monitor student use.
✓			18.	Teacher can modify the program.
✓			19.	Documentation is clear and comprehensive.

COMMENTS: Welding Safety tests specific skill devolpment of Safety in 13 Areas - cutting, equipments, tools, shop safety etc. Therefore may be applicable to several vocational Areas using the same tools/equipment.

PART 3 Overall Evaluation

CHECK ONE.

___Excellent program. Recommend without hesitation.
___Pretty good program. Consider purchase.
___Fair. But might want to wait for something better.
___Not useful. Do not recommend purchase.

Reviewer Name Ron Shrewsbury

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PART 2 Evaluation Checklist

Please check Yes, No, or Not Applicable for each question below. To add information, or to clarify an answer, use "Comments" section.

Yes	No	N/A		
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PART 3 Overall Evaluation

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___Pretty good program. Consider purchase.
___Fair. But might want to wait for something better.
___Not useful. Do not recommend purchase.

Reviewed by: Rod Shpensbury

IV. MACHINE SHOP
O. E. CODE 17.2302

Herley L. Bailey
Mercer County Vo-Tech Center

Albert Yanni
John Marshall High School

Ralph Brown
Ralph R. Willis Vo-Tech

Jackie O. Burton
Marion County Vo-Tech Center

William V. Butcher
James Rumsey Vo-Tech Center

Richard E. Cameron
Wheeling Park High School

Eugene G. Chewning
McDowell County Vo-Tech Center

Patrick H. Conley
Carver Vocational Center

Franklin D. Devores
Marion County Vo-Tech Center

Leon E. Earles
Cabell County Vo-Tech Center

Jack G. Elmore
Fayette Plateau Vo-Tech Center

Charles H. Ferguson
Boone County Vo-Tech Center

David Fernandes
Hancock County Vo-Tech Center

John M Bartram
Ralph R. Willis Vo-Tech Center

Donald E. Grubb
Wyoming County Career & Tech Center

James D. Harman
Randolph County Vo-Tech Center

Clyde E. Lilly
Raleigh County Vo-Tech Center

Melvin Forbes
Monongalia County Vo-Tech Center

Robert J. Manley
Carver Vocational Center

Daniel Whitacre
James Rumsey Vo-Tech Center

Norman L. McWilliams
Fred W. Eberle Vo-Tech Center

William Dillon
Taylor County Vocational Center

Michael Goodwin
United Career Center

James D. Taylor
Mason County Vo-Tech Center

John B. Williams
Ben Franklin Vocational Center

V. COMPANIES SURVEYED

Computer House Div/FLC Inc.
Jackson, Mi

Manufacturing Software Services
Cincinnati, Oh

McDonnell Douglas Automation Co.
Belleville, IL

Atek NC Corp.
Monroe, Ct.

University Computing Co.
Dallas Tx

Centech Inc.
Glenview, IL

AGM International
Arlington Heights, Il.

CAP-CAP Corp.
Memphis, Tenn.

Micro Software Devlopes, Inc.
Wilmette, Ill

FTG Data Systems
Stanton Ca.

Datamat Programming Systems, Inc.
New York, N.Y.

Shopsoft
Reno, NV

Comprep Corp.
Orange, CA.

Numeric Micro, INC.
Dallas Tx

Marco, Inc.
Sunnyvale, Ca.

Bluechip Enterprises, Inc.
Fraser MI

SOFTWARE SELECTION GUIDE

PROGRAM	DESCRIPTION	PRICE
Geo-STAC	GRAPHIC GEOMETRY + 250 LINE N/C EDITOR + N/C SIMULATOR.....(Apple) Define and calculate POINT, LINE and CIRCLE positions. Visual solutions for tough tangents, intersections and blends. 250 line text entry/editing and code processing system retrieves stored point calculations and types out final XYZIJK code, or use it as an electronic teletype/flexwriter. 'Dumb' mill/lathe simulator plays back word-address code as line-plot or with cutter animation to display metal removal swath. Includes communiation routines for DNC or tape prep. A programmer's tool-box.	$1095.00
Geo-STAC II	Enhanced 1000 line N/C Code Processor. Includes geo-STAC.....(Apple) Adds most functions not found in older N/C controls (scaling, mirroring, etc.) plus many automated formatting and processing functions such as auto-G coding, auto-code generation of quadrant points, climb/conventional reverse, etc. Cutter compensation and universal post processor included.	1595.00
Tape Prep/Edit	1000 Line N/C Code Processor & N/C Simulator without Geometry.....(Apple) Geo-STAC II editor turns your computer into an automated tape prep or DNC system for fast code creation.	895.00
STAC-PATTERN	Simultaneous three axis contouring software creates airfoil and swarfed surface shapes from section curve data. Go from mylar to core/cavity shapes quickly. Especially suited to wax pattern work for turbines, impellers and other complex shapes. Call for details. (Apple + 3 axis mill)	9995.00

PROGRAM	DESCRIPTION	
KWICODER	GRAPHIC GEOMETRY + EDITOR + GRAPHIC PLOTTING + COMMUNICATIONS ....(IBM PCjr) Graphic geometry, word-processing style editor, point swapping assembler routine and screen plot for effective manual programming with the PC or PCjr.	1495.00
PLC-CONTOUR	Automatic Programming System for all lathe, mill, EDM, Laser etc....(IBM-PC) Fully prompted system with by-passable menus for rapid-fire programming of <u>any</u> machine tool. APT-like power, but easy to use. For all two axis, two axis on canted plane, and simple 3D work. Features variables-programming for family-of-parts, rotation, mirroring, reverse pathing, scaling, tab-cyl, roughing, step-repeat, cutter-comp look-ahead, automatic fillet/blend, etc. Motion statements are simple menu references to desired Point, Line or Circle number. Easy to use and very comprehensive.	5495.00
PLC-MICROCAM	PLC-CONTOUR + Digitizing software on the front end and a mini-drafting package on the back end for small shops that design machinable parts. Use digitizer or keyboard to develop free-form or toleranced parts, your program is displayed and coded, ready-to-run. Document with the drafting package using an RS-232 Pen-Plotter. Quick-simple-effective.	7995.00
PLC-Posts	Post processors for specific machine tool controls convert universal code to N/C code according to machine need and your individual machining preferences. One post is included with CONTOUR or MICROCAM. Additional posts	500.00

Apple software runs on 48k, 16 sector DOS, (one drive OK), except STAC-PATTERN requires 64k AIIe.
IBM PC requires 256k, color board, and par/serial ports to suit peripherals.
IBM PCjr requires 128k, simple drive, (color monitor preferred), and serial port.

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